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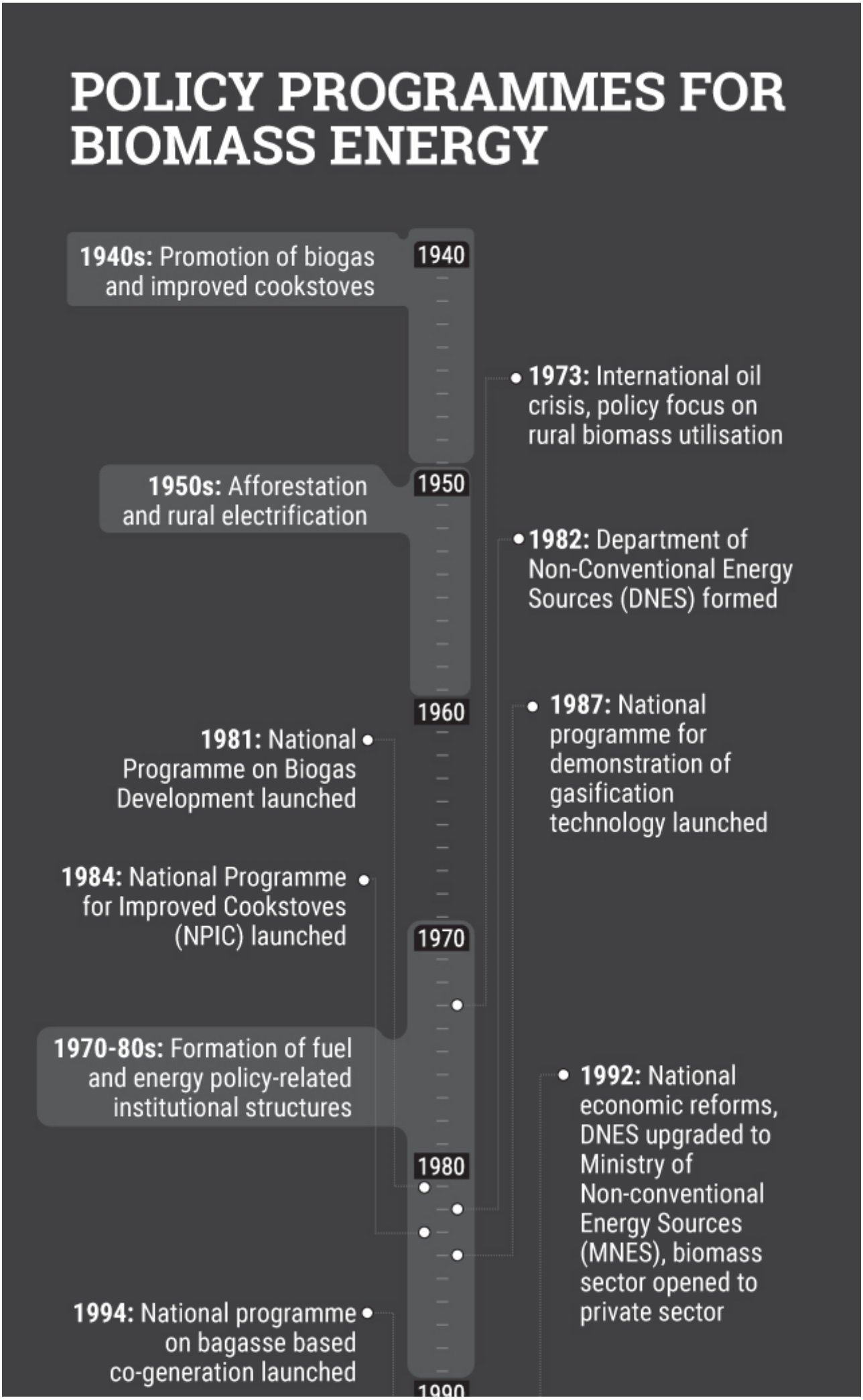
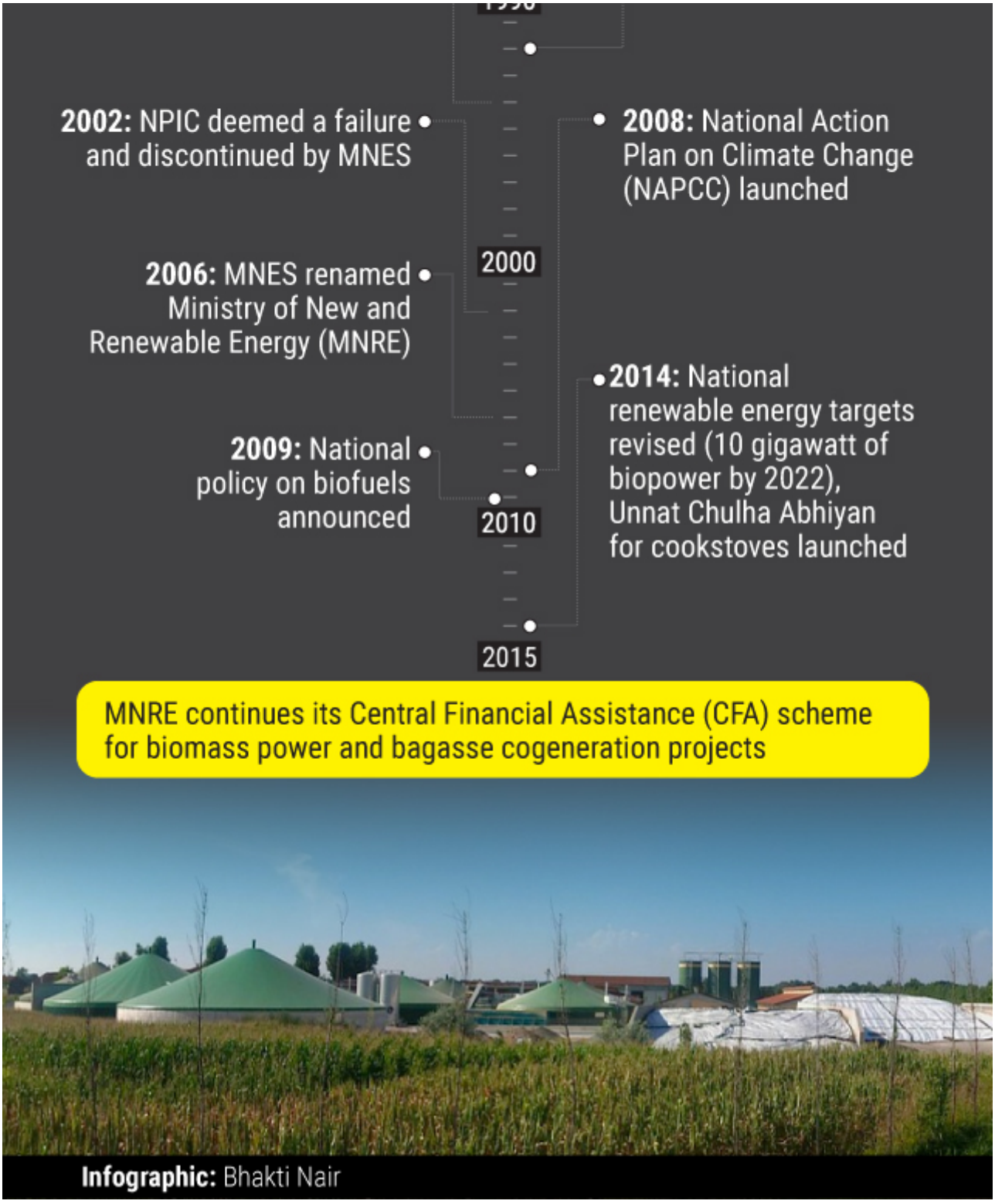
Biomass energy since Independence: The growth of a green driver of economy

Most of the global energy today is produced from the combustion of organic matter, whether fossilised (coal, oil and petroleum gas) or, relatively recent, biomass (wood, agro residue, etc.), releasing carbon dioxide at an unprecedented rate and threatening the stability of the climate. This has prompted a shift to clean energy generation from sources such as solar, wind and biomass, wherein the lifecycle of the technology is in harmony with the carbon cycle of the planet. As we approach 70 years of India's Independence, it would be worthwhile to look back at the nation's journey so far in utilising its bio-energy resources to reduce excessive dependence on fossil fuels, paving the way for a cleaner and safer future.

There are multiple ways of converting biomass into a useful form of energy, the simplest and most popular being the burning of wood for cooking. Thermo-chemical methods such as combustion and gasification are predominantly used for heating and power generation, while chemical conversion methods are used to convert biomass into liquid biofuels for transportation (biodiesel and bioethanol) and biogas for cooking or stationary power generation. The producer gas (or syngas) generated from gasification (energy-rich due to carbon monoxide and hydrogen) is used as a fuel to run internal combustion engines for stationary applications. The feasibility and evolution of these technologies depend not only on scientific and engineering innovation, but also on timely support by the government policies. Institutional structures and policy initiatives form an important part of a nation's infrastructure in transforming its energy landscape.


POLICY PROGRAMMES FOR BIOMASS ENERGY
1940s: Promotion of biogas and improved cookstoves
1940
1950s: Afforestation and rural electrification
1950
1960
1970
1980
1990
1973: International oil crisis, policy focus on rural biomass utilisation
1982: Department of Non-Conventional Energy Sources (DNES) formed
1987: National programme for demonstration of gasification technology launched
1981: National Programme on Biogas Development launched
1984: National Programme for Improved Cookstoves (NPIC) launched
1970-80s: Formation of fuel and energy policy-related institutional structures
1992: National economic reforms, DNES upgraded to Ministry of Non-conventional Energy Sources (MNES), biomass sector opened to private sector
1994: National programme on bagasse based co-generation launched



Evolution of biomass energy policy programmes

Programmes for promotion of biogas and improved cookstoves were introduced in India as early as 1940s. The 1950s witnessed some initiatives on afforestation and rural electrification. The 1973 oil crisis, coupled with the rising energy demand, catalysed the emergence of formal institutional mechanisms for supporting adoption of biomass as a local and affordable energy resource, especially in the rural areas. The years that followed saw the setting up of a series of committees and working groups on energy and fuel policy, leading up to the formation of the Department of Non-conventional Energy Sources (DNES) in 1982, whose major initial programmes included

facilitation of biogas plants and cleaner cookstoves. A national programme for demonstration of gasification technology was initiated in 1987, wherein 800 small wood gasifiers were promoted which supplied producer gas as a fuel to run reciprocating engines for irrigation.

The economic reforms of 1992 created a shift in the way policymakers approached biomass energy. This shift transformed biomass policies from being heavily regulated, supply-driven and majorly serving the rural needs to competitive, market-oriented approaches for mainstream power and fuel. The upgrade of the DNES to a full-fledged Ministry of Non-conventional Energy Sources (MNES) in 1992, which was later renamed the Ministry of New and Renewable Energy (MNRE) in 2006, was a major milestone in this context. The national programme on bagasse based co-generation was initiated in 1994 and boosted the combustion-based route for power generation from sugar industry waste. The second phase of the gasifier programme during the early 1990s shifted focus from decentralised off-grid systems to grid-connected power generation and development of larger gasifiers.

Development of cattle dung-based biogas units started as early as 1930s. The Khadi and Village Industries Commission (KVIC) floating drum model of biogas plant was one of the first major workable prototypes resulting from subsequent improvements in the technology. MNRE approved several biogas plant designs for larger dissemination as part of the National Programme on Biogas Development (NPBD).

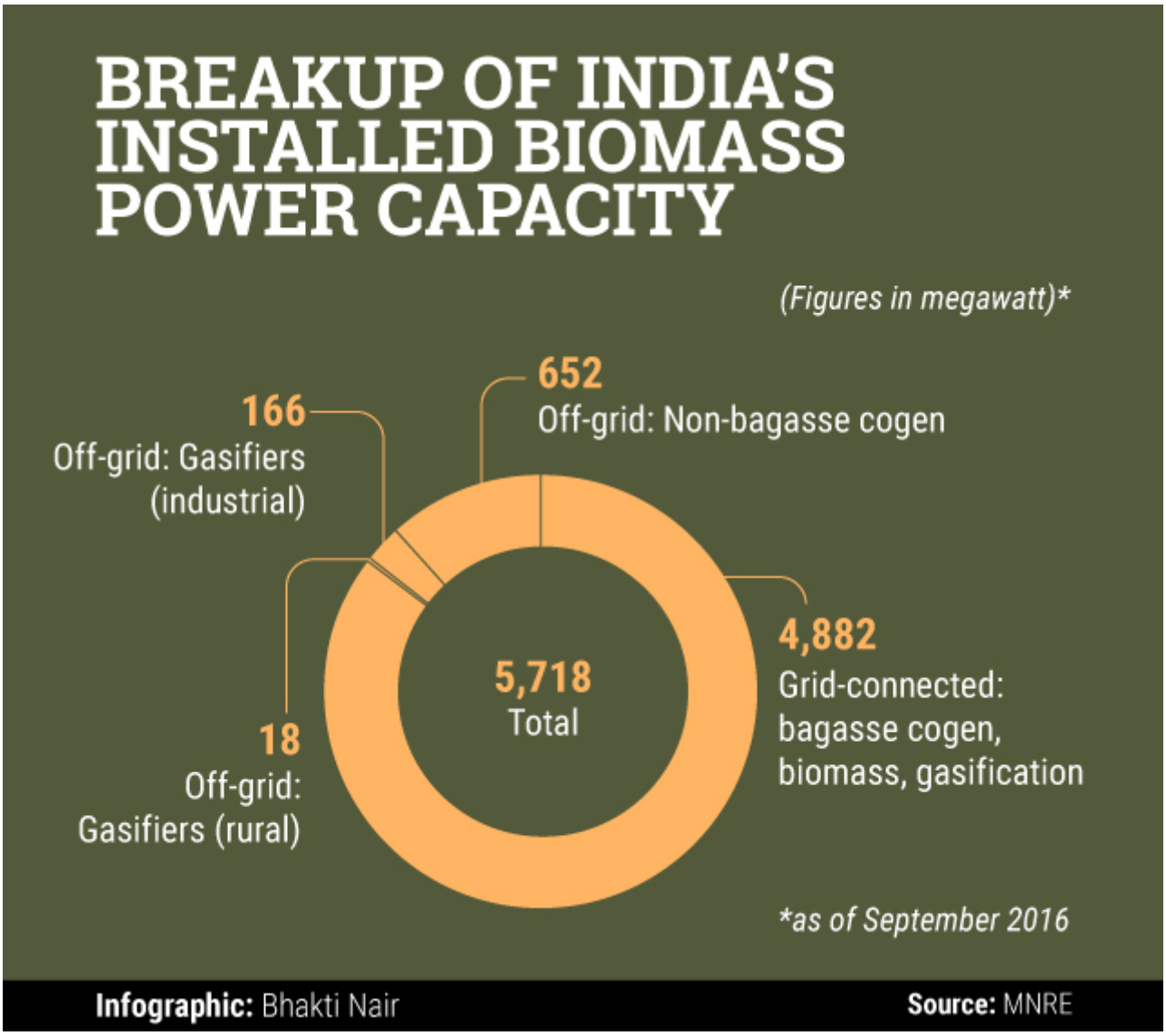
The MNRE initiated the National Programme on Improved Chulha (NPIC) in 1984, targeting a variety of issues such as fuel efficiency, indoor pollution and local employment generation. Professional institutions trained entrepreneurs to build stoves which were sold to the public with MNRE incentives. Despite disseminating millions of stoves across the country, the NPIC was discontinued by MNRE in 2002 because it reportedly failed to create a fundamental and widespread shift in the adoption of improved stoves.

Current policy programmes for biomass energy

The MNRE currently provides financial assistance and fiscal incentives to biomass-based technologies as well as support for research, development and adoption of indigenous technologies. Financial support schemes are available for grid-connected and off-grid biomass power projects for both the combustion & cogeneration and gasification technologies. The Biogas-based Power Generation Programme (BPGP) and the Biogas Power (off-grid) Programme also offer financial assistance for promotion of biogas for decentralised power generation in the 3-250 kW range as well as for thermal applications. The MNRE announced the national policy on biofuels in 2009 with a blending mandate of 20% bioethanol (in petrol) and biodiesel (in diesel) by 2017. The Ministry also initiated the Unnat Chulha Abhiyan Programme in 2014 for reviving the development and deployment of improved biomass cookstoves, with a target of disseminating 2.75 million stoves till 2017.

Status of biomass energy sector

As of September 2016, the total installed capacity of biomass power in India was 5,718MW, which was 12.1% and 2% of the renewable and total installed power capacity, respectively. The majority of installed biomass power capacity is grid-connected and in the form of bagasse-based cogeneration captive power plants in sugar mills.



The 20% blending mandate of the National Policy on Biofuels was subsequently revised to 5%, but is still not on track as the quantity of biofuel required outweighs its production. About 67% of the Indian population still depends fully or partially on traditional biomass for cooking needs. In other biofuels, about 20,700 lakh m^3 of biogas was produced in the country in 2014-15, which is equivalent to nearly 5% of the total national LPG consumption for the same period.

Outlook

The renewable energy targets announced by the Indian government include 10GW of biomass power by 2022. In addition, India's Nationally Determined Contributions (NDCs) as part of its ratification of the 2016 Paris Climate Accord aim at achieving 40% of the power generation capacity through fossil-free sources by 2030, which may translate to about 30GW from biomass. A reliable

and affordable supply chain of biomass still remains a hurdle in the viability of biomass projects in India. Hybridisation of solar thermal and biomass power plants can extend the hours of operation and bring down costs of generation, compared to a standalone plant of either technology. This approach has a two-fold advantage of addressing the intermittency of solar irradiation and reducing the requirement of biomass. Policies to promote pilot installations of solar-biomass hybrid plants can help experiment with various hybrid configurations and gather operational experience, enabling widespread implementation. Assessments of spatial and temporal availability of biomass at the district or taluka level need to be carried out after regular intervals and updated in public databases (such as the IISc Biomass Atlas), to improve certainty in the supply chain. Biofuel production, which currently depends wholly on the sugarcane industry for ethanol, can be readily augmented via the second-generation route (conversion of agricultural residues and residential wastes to liquid hydrocarbons) to meet the largely unmet blending targets without competing with food crops. Damage to stationary engines from long-term usage of biofuels and producer gas is currently a technological hurdle in the widespread adoption of these technologies and fuels. Increased research focus is thus needed in this direction.

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